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THESIS

USING COMMERCIAL AVIATION INFORMATION SYSTEMS IN OPERATIONAL SUPPORT AIRLIFT DECISION SUPPORT SYSTEMS

by

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September 2004

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13. ABSTRACT (maximum 200 words)

   Air travel within the Department of Defense (DoD) has the potential of being reinvented due to the disruptive technology of microjets. These smaller, more efficient aircraft will be able to provide cost effective point to point travel to their users. Along with this new way of travel comes the challenge of managing the customer requests, large networks of jets, personnel and support activities. Decision Support Systems (DSS) can help manage these networks by attempting to create optimized scheduling solutions for routing aircraft, crews and logistical support needed to successfully operate in this new environment. The opportunity exists for the DoD's private aircraft operation, the Joint Operational Support Airlift Center (JOSAC), to utilize some of the same system features used in commercial operations such as NetJets to improve operations.

This thesis will analyze the use of commercial air operator strategies and DSS's to be used in JOSAC to improve operational effectiveness. It will look to add new capabilities and processes used in commercial DSS's along with the implementation of the disruptive technology, microjets. Some of the potential benefits include improved operational performance, solutions to scheduling inefficiencies and improved mission readiness. With these improvements the potential for a military microjet operation in the future is a real possibility.

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Air travel within the Department of Defense (DoD) has the potential of being reinvented due to the disruptive technology of microjets. These smaller, more efficient aircraft will be able to provide cost effective point to point travel to their users. Along with this new way of travel comes the challenge of managing the customer requests, large networks of jets, personnel and support activities. Decision Support Systems (DSS) can help manage these networks by attempting to create optimized scheduling solutions for routing aircraft, crews and logistical support needed to successfully operate in this new environment. The opportunity exists for the DoD's private aircraft operation, the Joint Operational Support Airlift Center (JOSAC), to utilize some of the same system features used in commercial operations such as NetJets to improve operations.

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I.   INTRODUCTION

The air travel industry has the potential of being reinvented due to the disruptive technology of microjets. One potential use for these aircraft is to provide on-demand air taxi services. These smaller, more efficient aircraft will be able to provide cost effective point to point travel for their users. Along with this new way of travel comes the challenge of managing the logistics of large networks of jets, personnel and support activities. Decision Support Systems (DSS) can help manage these networks by trying to optimize the scheduling decisions for routing aircraft, crews and the logistical support needed to successfully operate in this dynamic air taxi environment. The opportunity exists for the US military airlift operator, Joint Operational Support Airlift Center (JOSAC), to improve their operations by looking at the systems of commercial air operators.

A.   BACKGROUND

The market for personal jet travel has the potential to expand in both commercial and military aviation. Microjets such as the Eclipse 500, seen in Figure 1, have initial purchase and operating costs that are one fourth of the cheapest personal jet aircraft on the market today, the Cessna Citation CJ II. Starting at $1.1 million each, these microjets could be the catalyst to make this new way of travel possible for the masses.

Figure 1.   The Eclipse 500 Microjet, www.eclipseaviation.com

Several companies, such as NetJets, currently operate personal jet charter outfits using modern jet and turboprop aircraft. They demand high prices for luxurious, personalized service. Several have grown into large networks of aircraft, enabling them to meet the travel demands of customers around the world. The incentives that drive the everyday business of these personal jet charters require them to optimize every aspect in order to squeeze out profit and remain competitive. Large investments in infrastructure and business process development enable these companies to succeed by operating at the highest productivity levels.

These operators have developed their own internal DSS in order to manage the networks of aircraft, along with the flight crews and other logistical components. As these systems evolve, their ability to reduce operating costs by increasing resource usage and improving the end product could open up an operating environment that can serve a much broader market. With potential reductions in cost and a new found competitive advantage over other types of air travel jet taxi networks could become reality. The end product of flying passengers on their schedule, to more destinations, more often is the ultimate result.

Along with the air operators, the system and software developers are shaping new management tools that will help transform the market. While these systems are not designed for military applications there are unrealized instances where components of these systems could be modified and immediately implemented.

JOSAC coordinates a similar fleet of aircraft to NetJets, which provides on-demand air travel to those Department of Defense (DoD) members who require private aircraft travel. While maximizing profit is not a concern, their chief interest is to ensure their mission objectives are met, within their budget. Several parallels can be drawn between the business practices of commercial air operators and military operations. If some of the DSS capabilities of profit driven operations were adapted to JOSAC operations, this could result in lower costs and increased operational performance. Better performance and these efficiencies could decrease workload levels, improve personnel utilization and possibly reduce operating costs.

In order for the DoD to embrace the disruptive technology of microjets and take advantage of the benefits, they should first find an efficient way to manage this technology. Observing industry leaders, and the tools they use to run their operations, is a starting point for setting a baseline to manage these new DoD networks.

B. OBJECTIVES

The objective of this thesis is to study the ways of improving operational effectiveness of JOSAC with commercial private aircraft operator strategies. Comparing the capabilities of commercial aviation DSS with the one used by JOSAC could yield new insights of how to adapt JOSAC's operation.

C. RESEARCH QUESTIONS

The question that will be answered in this thesis is:

- How can decision support systems used in commercial air operations be used to operate a network of microjets run by the Joint Operational Support Airlift Center?

D.   SCOPE

A limited feasibility study will be done to convey the new uses of microjets and their potential effect on the future of commercial and military aviation. This thesis will look for potential ways to manage these jets in a military organization. The JOSAC will be the primary subject due to its similarities to commercial operators. The focus of the research will be on the features, benefits and reduction in costs resulting from the use of a DSS to optimize the management of assets and logistics. Each of these systems will not be fully evaluated as if they were being purchased, but rather assessed for the efficiencies they create and how they could be applied. This thesis will not go into the technical aspects of how these systems are developed and all the variables needed to make them work this information will be presumed available.

E.   METHODOLOGY

The methodology for this thesis is as follows:

1. Establish a common baseline that defines the product category and types of systems necessary to manage operations in a Microjet network.
2. Evaluate the current operations and DSS used by charter and fractional aircraft networks that fit within the personal jet category.
3. Evaluate the current operations of JOSAC's Joint Air Logistics Information System (JALIS).
4. Identify opportunities to contribute to JOSAC's mission through potential improvements to JOSAC's operations and JALIS.
5. Compile the results of the previous evaluations into a solution that could potentially improve the scheduling of JOSAC's aircraft network.

F.   ORGANIZATION OF THE STUDY

This thesis contains the following five chapters covering the research on decision support systems to manage a DoD network of microjets.

Chapter I contains the introduction, objectives, research questions, scope, methodology and organization of the study.

Chapter II contains background information on microjets and identifies their potential impact on the air travel market.

Chapter III presents the benefits of a DSS that has been realized by personal jet operator NetJets.

Chapter IV contains background on the Joint Operational Support Airlift Center and how they are currently using JALIS.

Chapter V will compare commercial and military DSS's and identify features that could be used in a JOSAC operated microjet network. It will also make recommendations for future JOSAC applications.

G.   CONCLUSION

Some of the potential benefits are improved operational performance, solutions to large inefficiencies and improved mission readiness. With these improvements the potential for a military microjet operation in the future is a possibility.

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II.   PRIVATE AIR TRAVEL

This chapter will explain how new technologies are changing air travel and the environment in which they operate. First, it looks at the current travel options and market trends that have pushed commercial aviation's evolution. Then it addresses the new technologies offered by microjets that will take air travel to the next level. It will identify several key factors that are needed for the next generation of air travel to be successful.

A.   AIR TRAVEL MARKET

Private air travel has always been a part of the aviation industry however, the overwhelming majority of passengers travel on large commercial air carriers. The current "hub and spoke" routing system that is used by large airlines, (Fig 2 part a) is an efficient model, for the carriers. But this way of travel can be time consuming and inconvenient for the traveler. This system dominates because of price and the lack of a desirable customer oriented substitute. Part b of Figure 2 displays "point to point" routing used by some airlines, such as Southwest or private charter companies, still flying into large airports without connecting flights. The future of air travel is moving from a centralized, highly coupled structure to a more personal, decoupled way of traveling as seen in Figure 2 part c. This move is due to the development of personal microjet aircraft (Holmes, 2004). In the near future, air travel could transform into a large network of small jet aircraft, flying point to point routing, directly to and from smaller local airports, drastically cutting total travel time (Fallows, 2001). The eventual goal is to have a distributed "on demand" travel network, as seen in part c of Figure 2, which would drastically increase the potential number of travel destinations. The scheduling of these flights would be based on the passenger's schedule rather than the airlines.

Figure 2.   Value of networked travel increasing travel options. (After Holmes, 2004)
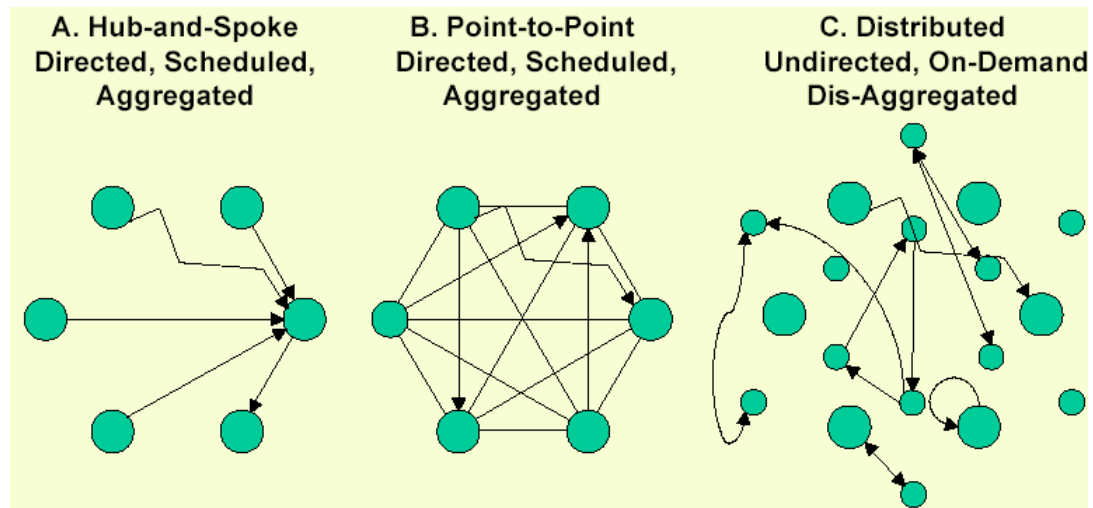
Private air travel is currently realistic for very few. It has been limited to the ultra-wealthy because of the high cost or to general aviation pilots due to the level of training involved. These two small populations are the only travelers that experience "on demand" air travel today, instead of this being available to 98% of the population (Holmes, 2003). Only with the advance of several key technologies and the successful marketing of on-demand, private air travel, can this become reality. The current technology has not been able to produce an aircraft that can deliver private air travel at a price that would be widely accepted. Furthermore, the typical traveler is unaware of the potential travel options and benefits available with a private aircraft. The newest personal jets, called microjets, have the potential to open up this once elite way of traveling to a larger portion of travelers who desire convenient on demand air travel at a realistic price.

1.   Current Options

a.   Suppliers
The current air travel marketplace consists of the following suppliers: large commercial airlines with a hub and spoke routing system (part a), smaller regional

airlines that provide limited point to point and connection travel (part b), and charter airlines that fly distributed on-demand routes in a variety of aircraft types (part c). According to the National Plan of Integrated Airport Systems (NPIAS) nearly 95% of all enplanements in 1998 took place at a large or medium hub airport on a large or regional airline (Fallows, 2001). The remaining 5% was made up of general aviation and charter flights, mostly flying in and out of regional and other general aviation airports (Fallows, 2001). This overwhelming bias towards traveling on large commercial air carriers can be attributed to their low cost and quicker travel times compared to similar travel options of trains or automobile (Fallows, 2001).

b.   *Demand*

On the demand side of the market, Fallows states that customers fall into three general categories: the leisure traveler looking for value in getting from point to point, the business traveler looking for convenience and comfort, and the time conscious traveler who values the fastest, most productive way at a higher cost. While there are hybrids of all three categories, the demands of the typical traveler in these categories help separate them. Both the leisure and business traveler will use large or regional air carriers because they are the only available option in meeting their demands while staying within their budgets. These travelers accept the status quo of traveling on the airline's timetable using an indirect routing structure because it is most often the only choice. The average door-to-door travel speed, meaning the average speed from doorstep to destination, by large air carrier passengers has decreased each year since 1999. This is the first time in the past fifty years that the average door-to-door travel speed decreased (Fallows, 2001). This deterioration results from increased security and the overcrowding of large hub airports that cause system wide delays. According to Fallows the average door-to-door travel time increased by 20% for domestic flights since 1980, while jets only got faster and more efficient. This is evident at airports like O'Hare in Chicago where both United and American Airlines have hubs. Both of these major carriers have been required to reduce their scheduled flights by 5% and move more flights to off peak hours in an effort to help ease congestion and prevent delays which slow the entire national air transportation network. When speaking on the subject of delays in August

2000 Todd Hauptli, senior vice president for policy and government affairs of the American Association of Airport Executives, stated for the *New York Times*,

> As long as a passenger is willing to get on an airplane, airlines tend not to think of how long it takes you to get there, the parking hassles, getting through the terminal. All they care about is that you get in one of their seats (Fallows, 2001).

While most airlines claim to value their customers above everything else, Hauptli's statement clearly illustrates how current air travel is not customer centric. As seen in Figure 3, large commercial airline travel is reaching its innovative peak and is entering the stage of being a commodity. Like with any other product that becomes a commodity in the eyes of the consumer, it becomes extremely difficult to establish a competitive advantage.

Figure 3.   Life cycle of airline travel. (After Holmes, 2004)

The time conscious traveler, who values time and productivity at any cost, feels life is too short to spend it traveling between places and will pay whatever it takes to

get there quickly. Very few people currently have the means to make this a realistic travel option since it requires an available jet and a dedicated crew to be on call. But if money is not a constraint, this way of traveling would be the preferred method over large airlines. Thus, cost is currently the main factor preventing all travelers from flying in a truly efficient and convenient manner.

These market trends are slowly changing from the centralized structure of today to a more decentralized personal way of traveling. According to the National Business Aviation Association, in 2002 charter aircraft travel increased by 30% largely due to the increased hassle and inefficiencies of traveling with a large air carrier (NBAA, 2003). Seeking convenience and the value of private air travel, more travelers are willing to pay more to avoid the current alternative. Using the laws of supply and demand, if a supplier can bring a product to market at a drastically lower cost than the rest of the market, they will open up the market to more customers, which increases the market size. At the right price level enough customers can see the value and will create a large enough customer base to be able to sustain operations. This is the number one factor in determining how well the idea of a customer centric jet taxi service will catch on and become a legitimate travel alternative.

2. Future Options

The future air travel market could consist of private jet networks servicing local airports to meet customer requests on-demand. These jets would provide true point-to-point, distributed travel, cutting travel time drastically while increasing convenience. The aviation industry has seen the size of aircraft continually grow over its history, but that trend has reversed as seen in Figure 4. Currently, research and development of smaller aircraft is driving the industry to reverse its production trend of large aircraft. In 2002, the General Aviation Manufacturers Association said there is a 20% increase in the number of firms owning and operating their own private plane (Wetzler, 2004). Large airlines are recognizing the decentralized trend and are turning to smaller regional jets to provide limited service to more local locations to meet the increased demand. As can be seen in Figure 4, the number of available seats on both domestic and international airline flights has dropped significantly over the past ten years. In part this trend can be

attributed to the use of smaller more economical regional jets. Also the demand from passengers for more legroom in sections like United Airlines Economy Plus has caused seats to be remover in order to make room.

Figure 4.   Trends in number of seats per aircraft (After Holmes, 2004)
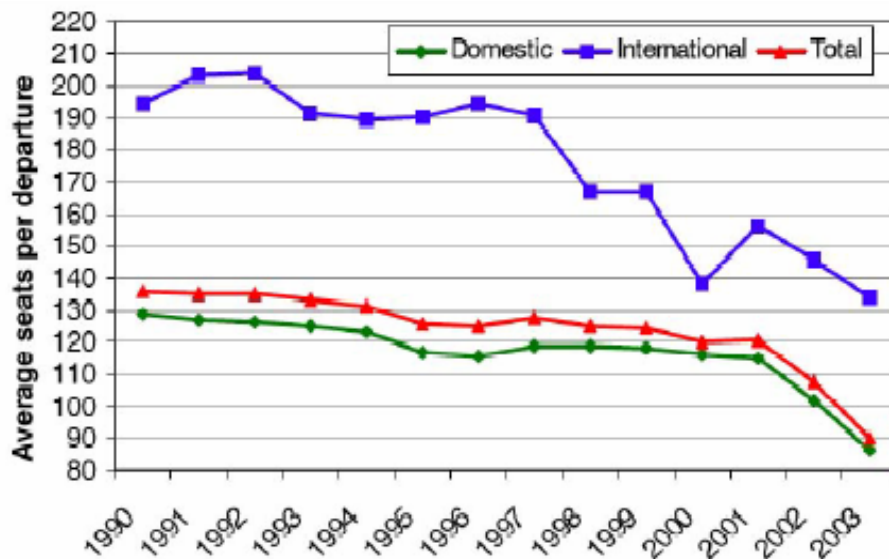
This trend could be one of the first steps towards a fundamental shift in the air-travel industry. The technologies necessary for this new disruptive product life cycle are only a few years from becoming mainstream, thus launching a new market for air travel that was only available to the luxury travelers of the past. As seen in Figure 5, the next S-curve transportation lifecycle is beginning to take off, with microjets as the main driver (Holmes, 2003). Over the next few years, the necessary conditions will begin to materialize as consumers embrace this new way of travel, creating the upward trend in market acceptance.

Figure 5.   Life cycles of transportation. (After Holmes, 2003)
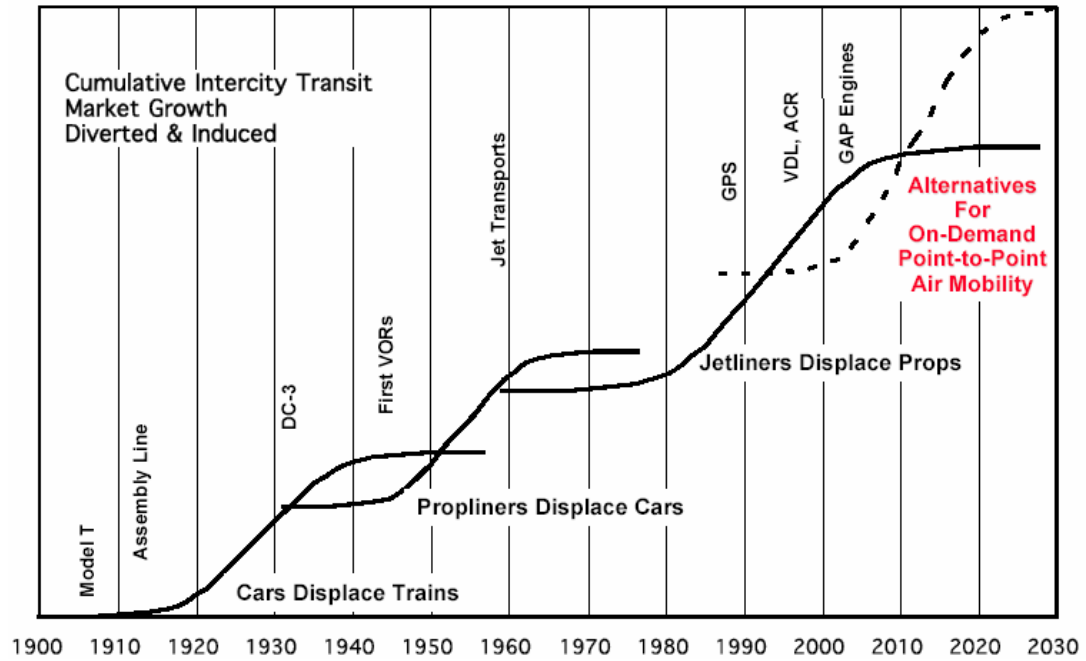
a.   *Key Drivers pushing Air Travel's new lifecycle*

There are several key factors that are driving the industry towards the use of microjet networks. The factors are government support, economic considerations, emerging technologies, and customer demand. These factors, along with several other factors listed in Figure 6, show how the air travel system could transform in the 21st Century.

Figure 6.   Transportation system changes (After Holmes, 2004)

System	Current "Hub and Spoke"	Future "On Demand"
Doorstep to destination travel speed	75 mph	200 mph
Airport Networks	Hub and Spoke	Distributed
Air Transportation Services	Scheduled	On Demand
Air Crews	Two Pilot	Single Pilot
Economic Opportunity	Centralized	Diffused
System Growth	Constrained	Scalable (up and down)

(1)   Government Support: The NASA small aircraft transportation system (SATS) is a program that is promoting the use of small aircraft such as microjets as a primary method of travel to create an on demand, widely distributed transportation network. The basis for this system lies in the fact that 93% of the United States population lives within thirty minutes of an airport where a microjet can operate. Only 22% of the population lives within 30 minutes of a major hub airport, thus making any type of air travel extremely inconvenient and time consuming for the large majority (Holmes, 2003). The SATS program provides local communities with funds to invest in the infrastructure required to support small aircraft operations, including instrument approaches and larger airport facilities. When SATS is made a reality, huge savings in doorstep to destination travel time can be realized. The time saved adds up to millions of hours when comparing the current system to traveling on a SATS aircraft. Figure 7 shows the potential time savings for travelers who flew on SATS aircraft. The blue line represents the time savings by flying into the current set of 3364 instrument approved general aviation airports as compared to the red line displaying flying only to large hub airports. For example, if SATS was able to use an aircraft that cost $1.50 per seat-mile and used the 3364 airports, there could be time savings of over fifty million hours in travel time as seen in. These potential savings, on top of the current air travel network problems, has the government's attention in its quest to find new ways of operating the national air network.

Figure 7.   Potential time Savings with SATS (After Hefner, 2004)
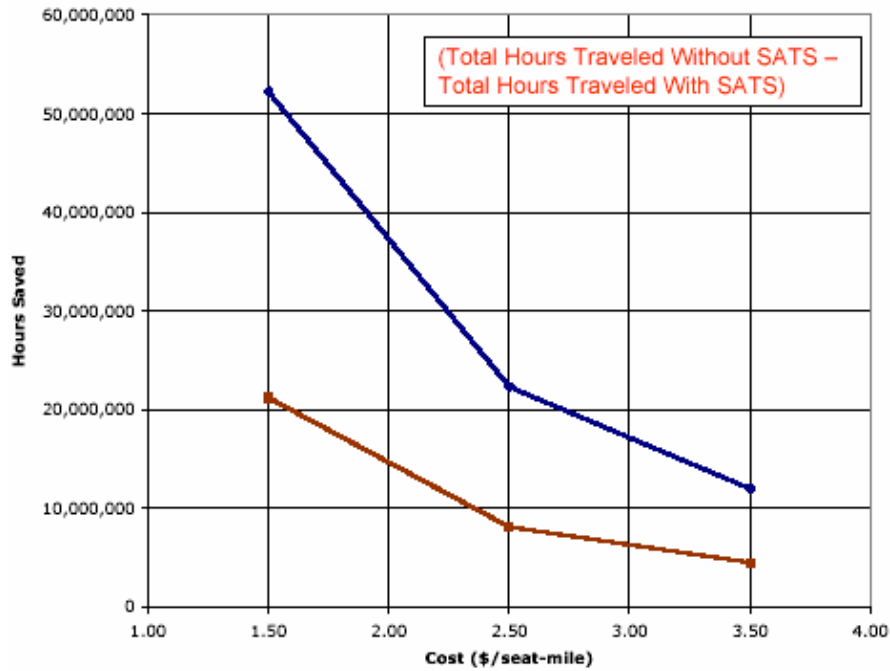
Bottlenecks are being created at a handful of major hub airports including Chicago's O'Hare, San Francisco, Dallas Fort Worth, LAX and New York's LaGuardia Airport (Fallows, 2001). With delays at these airports rippling across the entire air traffic network, an alternative needs to be found. Intense research is being done on the potential benefits of decentralizing the main airway transportation network by pulling passengers away from large hub airports and sending them to local airports. This would give the transportation system the room it needs to continue to grow and serve a greater amount of the population.

(2)   Advances in technology lead to new efficiencies: As the average size of the aircraft get smaller so will the number of crew members required to operate these aircraft. The workload to operate these aircraft is drastically reduced with the use of advanced avionics and other emerging technologies. Most small jet aircraft require two crew members when operating under part 135 of the Federal aviation regulations which governs charter aircraft operations. Legislation is now being passed to reduce this number to one crew member for the new microjets, cutting personnel costs for pilots in half. This is just one of the efficiencies that microjets provide without

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compromising safety. The advances in aircraft construction techniques along with the development of ultra efficient engines make these aircraft cost effective to operate.

        (3)   <u>Target Market</u>: The initial target market for this type of service will lie between two extremes the over served executive and the underserved business traveler. At one extreme are those travelers who own their own jet, including top executives and General officers in all branches of the military. The other extreme is the typical business travelers who want convenience and comfort, but have to settle for an occasional upgrade on a large airline because of costs. In between these two extremes lie several potentially underserved markets that might embrace a jet air-taxi service at the right price.

        One of these potential markets are small corporations who have managed their own private aircraft in the past, or those who are seeking some type of private air travel but do not want to tie up large amounts of money in aircraft. Many small corporations cannot afford the initial purchase price and the operating costs associated with owning a jet outright. The supposed solution to these large costs was the advent of fractional jet ownership networks where costs are shared. However, even the purchase of a fractional share in an aircraft is becoming less attractive for these same reasons along with avoiding long contracts. Using microjets within the transportation system would move the economic benefit from a few large corporations to a distribution over the entire country with growth in many local airports providing benefit to those communities. Through the use of an air taxi service, the traveler would have the benefits of owning their own jet without any of the fixed costs, seen in Figure 8.

Feature	Fractional Ownership (NetJets)	Airline Coach	Delta AirElite	Microjet Air Taxi
Average Hourly Cost	$1415	$96	$3280	$1000 est.
Seats available	5	1	5	5
Average Cost/ Seat mile	$0.74 without other costs	$0.25	$1.70	$0.51
Contract Commitment	5 years	None	None	None
Aircraft Acquisition costs	270 K - 1.5 Million	None	Prepaid card	None
Monthly Mgt Fees	$4000 - 8400	None	None	None
Annual Flight	100 hours	Unlimited	Unlimited	Unlimited

Assumptions: travel airspeed of 385 mph, using light jets.

The largest potential group to benefit from a jet taxi service is the frequent business travelers seeking a better alternative to flying with large air carriers. These travelers value the convenience and prestige associated with flying on a private jet, and they are willing to pay slightly more for the privilege. Time is the most important resource to these travelers and they desire to spend a minimal amount of time traveling. This new way of travel fits this group's needs by drastically increasing their overall door-to-door travel speed as seen in Figure 9. The average door-to-door travel speed is increased by flying out of a closer airport from the traveler's origin, avoiding check-in and security lines, along with the requirement to be at the airport early, not having to make a connecting flight, and finally landing at an airport that is closer to the final destination.

Figure 9.   Average speed of different types of travel. (After Holmes, 2003)
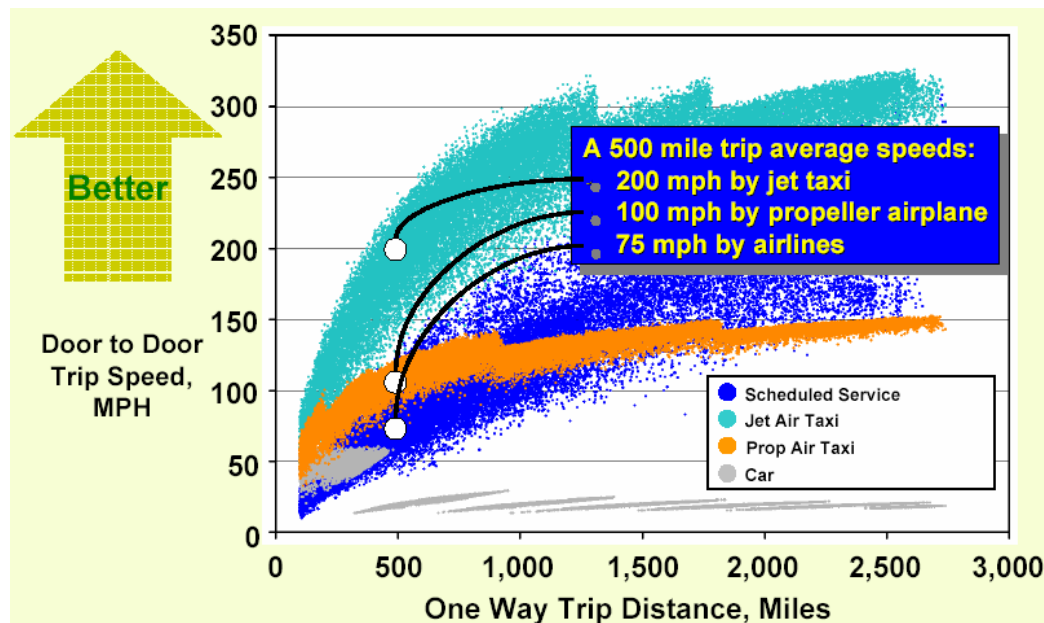
A recent study conducted by J.D. Power and associates reports that traveling by private aircraft can save a frequent flier a month of time annually (Wetzler, 2004).   Rather than spending large amounts on last minute airline tickets, business travelers get a much better experience for a slightly higher price displayed in Figure 8. While the average cost per seat mile on an airline is roughly twice that of an early microjet air taxi, the cost of a last minute airline ticket, purchased less than seven days in advance, can be two to three times the average.

Travelers who need to interact with a group or who desire privacy, such as a product team, could also benefit from the use of a jet taxi service. With product teams or other work groups, productivity and the ability to collaborate during a flight add to the convenience and value of the service.   Furthermore, those who travel to destinations outside of metropolitan areas or rural locations can save tremendous amounts of time avoiding long drives to and from large hub airports.

3. Keys to Making Microjet Travel Work

There are several key factors that need to be in place in order for this new way of travel to be successful. They include large enough demand to achieve economies of scale, and efficient operations (Holmes, 2003).

a. *Sufficient Market Demand*

Microjet travel needs to be introduced at a reasonable cost that is comparable to that of business class or full price airline tickets. A NASA study determined that with an operating cost of approximately $2 per statute mile travel the demand for air taxi service would be between thirteen and forty-seven million trips (Holmes, 2003). A regional SATS study did a market assessment for on-demand business travel throughout the state of North Carolina, focusing on communities not served by a major hub airport. This market was characterized by those who live more than thirty minutes away from a major hub airport, making up 48% of the population. In order to meet the business travel needs of these communities would require a fleet of 175 next generation microjets to serve the 425 passengers per day demand at $1.85 per passenger seat mile. The highest demand for this travel was from those who lived in the most remote communities (Holmes, 2003).

If microjet air taxi services are implemented on a nation wide scale the number of aircraft required to serve the new customer demand, will be between 7000 and 52,000 aircraft (Holmes, 2003). In addition to the aircraft, enough support personnel and a robust infrastructure are required to ensure they can meet the demand in a timely matter. Providers must establish the customer's trust by delivering convenient air transportation on time when it is needed. If that trust is broken or never established due to poor service microjet travel may never get off the ground.

c. Efficient Operations: Automated Decision Support Systems

The need to coordinate a microjet network's assets and personnel in a dynamic environment is crucial to sustaining operations in order to compete and be profitable. The use of efficient aircraft, plus the technology to automate business processes which manage these assets is critical to creating a seamless travel experience for the customer. Management needs a decision support system to ensure they are operating in an efficient way because of the large number of assets working constantly to meet demand. Table 1 lists the advantages and disadvantages of an automated system. By using automated systems for processes like scheduling, reservations or changing customer requests, allows the organization to process more demands using less time and personnel. Automation is not the total solution and can cause a decrease in attention to detail, which was an advantage of having an individually manually process a task. However in most areas it can increase processing speed, organization and accountability. The importance of these systems can already be seen in fractional aircraft operations today.

Table 1.   Advantages and Disadvantages of Automated Systems

Advantages	Disadvantages
Can Increase Processing Speed	Lacks Attention to Detail
Enables User to Take on Larger Tasks	Can Overwhelm User
Increases Accountability	User Requires Specific Training
Provides Information to Multiple Users	Could Restrict Ability to get Desired Information
Can Propose Near Optimal Solutions	Could Slow Down Some Communication

Fractional aircraft ownership operations are relying on increasingly complex software programs to orchestrate their growing operational requirements as jet fleets continue to expand and the job of meeting owner's demands becomes more competitive (Velocci, 1995). These operations currently are the closest thing to air taxi

networks serving well-to-do customers who have bought into a share of an aircraft. The largest provider in the fractional ownership market today is NetJets, managing a fleet of 512 private jets in the United States and Europe.

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III. NETJETS: INDUSTRY LEADER IN PRIVATE AIR TRAVEL

This chapter examines the current industry leader in private jet travel, NetJets, and the DSS they have developed Intellijet II. This DSS is one of the best aviation DSS's to manage a fleet of smaller aircraft flying on-demand routing, and could provide a model for how all air travel could be managed in the future. This section will break down the lessons that can be learned from NetJets strategies and operations. It will focus on the Intellijet II system, the benefits and efficiencies that have been created by implementing this decision support system. The information will be broken down into background information, what the system provides, system features, and infrastructure development challenges and solutions. This system will be compared to JOSAC's system, JALIS, in later chapters to find opportunities to apply these new DSS technologies.

A. BACKGROUND INFORMATION

NetJets provides fractional aircraft ownership in a wide variety of aircraft. With ownership comes the privilege of on-demand air-travel using a fleet of 512 private jets in the U.S. and Europe. In as little as four hours, NetJets guarantees it can respond to its customers' demands to be flown nearly anywhere in the world. They provide full service travel arrangements from the time a client leaves home until arriving at the destination. Managing the vast number of changing details for a typical flight has created one of the most complex logistics operations in aviation. NetJets employs 2800 pilots flying 250,000 on-demand flights annually to 140 different countries (ebiz, 2003). They serve 3500 customers all over the world, catering to each individual's personal needs.

General Dick Lassiter, an air-travel visionary, along with actor Jimmy Stewart, General Paul Tibbets and General Curtis E LeMay, started the company in 1964 (Bettridge, 2002). These celebrities and wartime heroes felt there was a new market for personal jet aircraft transportation. They applied the principles of air force aircraft management and originally ran their company like a military operation. In 1986, NetJets begin selling fractional ownerships in business jets. Eventually this operation was bought out by the Berkshire Hathaway Corporation after its owner, Warren Buffett, had been an

extremely satisfied customer for several years and wanted to expand the company from its original eight aircraft. In 1994 NetJets began using Intellijet I, their first system that automated reservations, scheduling, crew records, invoicing and maintenance. By the late nineties the company had grown to nearly 300 aircraft and could no longer rely on the old technology of Intellijet I. This growth led NetJets to develop Intellijet II, an all encompassing aviation DSS.

B. INTELLIJET II

1. Overview

Intellijet II has been called the most sophisticated flight management tool in aviation (CLO, 2003). This proprietary software handles all aspects of customer relationship management (CRM), scheduling and execution of flight operations (ebiz, 2003). This system with 1.5 million lines of code, three times the amount in Intellijet I, is expected to handle NetJets growth from five hundred to around one thousand aircraft (Velocci, 1995). This translates into employees informed of the dynamic needs of their customers, allowing them to be a step ahead in providing the best customer service. The new system allows NetJets to align the entire company around a shared awareness of events (ebiz, 2003). For the leaders of the company, the system provides an enterprise wide, aligned logistics system, capable of running the entire NetJets operation from the common view of the underlying data (Persistence, 2003).

2. What the System Provides

The main purpose of Intellijet II is to send the right information to the right employee, anywhere in the world, in time for it to be useful (Persistence, 2003). It can push last second information to flight crews via blackberry pagers. Future upgrades will enable NetJets suppliers such as limo services and travel agencies to receive automatic updates to itineraries (Lindquist, 2003).

The best way to illustrate how this system functions is to show its features in a typical billing scenario, from when a flight is booked to when it is executed. A customer

will either call or book a flight using the website, state their desired departure and arrival airports, the times they would like to leave, the number of passengers traveling, the size of the jet, their ground destination or any other ground transportation needs and any other requests such as meal preferences. NetJets guarantees they will have an aircraft ready to go in as little as four hours notice. If they are unable to accommodate the request using their own fleet they will charter a jet from an outside supplier, ensuring the customer's travel needs are met. This information is put into the reservations database where the data is used to drive a number of processes. First, before the reservation is confirmed and the customer is still on the phone or at the computer, the system checks the proposed itinerary against any potential problems, such as airport curfews, runway lengths, potential alternate airports that are closer to the final ground destination, weather or inadequate ground services. The ability to check these factors before the customer walks away prevents last minute disappointments or inconveniences.

Several planning events can occur in parallel, such as scheduling the closest aircraft that meets the customers' request and arranging crews and ground transportation. The system attempts to minimize empty flown legs by upgrading the client's aircraft if it is beneficial to planning. The allotted amount of time it takes to fly to pick up the customer and take them to their destination is blocked off for that aircraft. Next a flight crew is scheduled for that aircraft by assigning them to that aircraft for that trip. Pilots are scheduled to work seven days on-call and seven days off. During those days on-call they are limited to a certain number of flight hours per day and per month. With crews being the limited resource, flight crews may be flown on airlines to take over for a crew that has flown their maximum amount. NetJets will spend close to $70 million per year on crew airline tickets to put crews in place and bring them home (Velocci, 1995). Since their pilots only fly one specific aircraft type, they may fly several customers in a row staying with the same aircraft. A flight attendant is scheduled in a similar way for those aircraft that require it. Ground transportation will be arranged by scheduling either a limo or rental car that will be waiting for the customer at the aircraft when it arrives. Along with this the ordered meal served onboard is submitted to the supplier. Currently, these factors and services are coordinated using phone and other systems by a planner

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who makes the reservation. In the future, these factors will be generated automatically with every supplier's system being integrated into Intellijet II.

As the time for the flight approaches another check will be done to ensure all the elements are in place to meet the customer's request and then assets are put in motion. The flight crew will be either flown into place or fly the jet they are currently with to pick up the passengers. Blackberry devices are used by the pilots to receive current schedules and any changes. They will coordinate with the NetJets weather department to get the most up to date weather briefing. The aircraft and the crew will be in place at the airport with all preflight checks, meals on board, maintenance done and the jet ready to go before the passenger arrives. When the customer arrives at the departure airport they immediately board the plane, and within minutes, are airborne. NetJets operations department tracks the entire flight, updating its status and tracking the potential conflicts with later flights should an aircraft be delayed for traffic congestion or weather. The system is constantly updating all aircraft's estimated arrival times, using this information to help coordinate where each aircraft will go next. A ground crew at the destination airport, usually outsourced to a local supplier, is ready to receive the flight and has the ground transportation waiting on the customer's arrival. This coordination varies with different airports and suppliers; it will eventually become integrated into Intellijet in the future.

When the flight arrives the customer walks straight from the aircraft to their car or limo and is on their way, bypassing the inconvenience of waiting in line along the way. The customer's experience has ended, however the system is still working to coordinate the aircraft. The system ensures the aircraft gets the necessary attention such as fueling, cabin cleaning and any minor maintenance. Finally, the system integrates billing for the flight just flown, charging the customer for the flight time flown and any additional services provided. In addition to the customer billing, the system handles paying out invoices to the suppliers that provided services along the way. The desired end result of a stress-free customer experience is achieved.

In a perfect world reservations would never change, all aircraft and personnel would be available at all times, and flights would be scheduled so that the delivery of one

passenger corresponds with the next passenger waiting at the same airport. This scenario is the rare exception for NetJets operation, but Intellijet II has made dealing with non ideal world manageable. Their operating environment is extremely dynamic due to customer demands, asset constraints, and scheduling variability.

According to Mike Midkiff NetJets CIO, the norm for NetJets operations is that many of the owners have ever-changing schedules. NetJets needs to be able to react quickly to modifications. For example, if a New York business executive calls at 8 a.m. to change his 10 a.m. Chicago flight to a 1 p.m. flight to Los Angeles, NetJets needs to prepare a different plane for the longer trip. It also has to arrange for a different pilot, to have the executive's preferred lunch instead of breakfast on board, and to adjust any previously scheduled ground transportation (Picarille, 2004).

When changes occur, the software creates an interactive task list to start the process of creating a solution. The system sends the necessary updates or new requests to the parties affected by these changes. This information is available in real time to anyone else in the organization that may need to access it. Once these messages are sent, the system confirms receipt of the information and each department's response. This level of assurance within the system ensures the necessary actions are being accomplished. If the needs cannot be met, the system will find other resources, such as an outside charter aircraft, to meet the customer's demand. "The primary goal of this capability is to improve the service level to the customers while reducing overhead costs.

3.   System Capabilities

With the implementation of Intellijet II, NetJets has enabled themselves to automate and consolidate many of the everyday operations that were previously done manually. Intellijet II allows NetJets to manage their rapidly growing fleet of aircraft and subsequent growing number of crews and support staff. They have taken an all access approach, making data available across the enterprise, which allows employees to make better decisions from better information. Midkiff says, "We have moved from a manual system, to one that takes about two seconds to book and is continually synchronized and delivers an entire set of workflows with vital customer data to everyone who needs to

know, just in time for it to be useful." He also added, "We believe this approach is already reducing database hardware and software costs enough to pay for its deployment.

a. *Real Time System Synchronization and Data Alerts*

The integrated real-time view of customers and operations across the company also provides a significant competitive advantage by enabling us to provide better customer service more cost effectively than our competitors" (Ebiz, 2003). NetJets expects to save nearly forty percent on their IT infrastructure costs by using a virtual data center which allows them to deploy applications without the need for replicated databases (Persistence, 2003).

Without this capability, it would make coordination between functional departments extremely difficult with trip details changing as fast and as often as the customer's schedules. By keeping the data throughout the system updated in near real time gives the entire enterprise a common operating picture which users can manipulate to meet customer demands. Having a system that pushes and pulls changes, requests and responses eliminates the need for multiple coordinating phone calls to bring other involved parties up to speed. It also makes interactions with extended enterprise suppliers such as ground transportation or catering suppliers much more efficient enabling them to also be alerted on changes.

b. *Itinerary Feasibility Engine*

Another key feature that helps address problem areas within operations is the Intellijet II feasibility engine. This feature caches the details of a trip problem, like an aircraft capability shortfall, airport curfew or a customer's specific catering request during the initial customer request. The system also has stored all the details, from runway lengths to aircraft support needs to customer's beverage preferences, needed by the system to constantly check against to ensure the flight's success. The system uses this information to make choices to assign an aircraft that will be able to land and takeoff in the expected weather conditions at a specific airport. The system has been able to capture the knowledge and decision criteria of what is typically done by personnel in a

planning department, and apply that knowledge by putting the correct assets into motion. A smart system that can handle the vast majority of planning eliminates most of the manual inputs that were done in the past.

c. *Scenario Planner*

While large savings in planning are created by an automated system, some details require planners to check on specifics, make changes or account for unusual circumstances. To help planners make well-informed decisions the system allows them to develop a set of potential scenarios without modifying a customer's actual itinerary. The planner can enter in a number of aircraft usage scenarios in order to try to minimize empty flight time while catering to a customer need. Once the planner has found a scenario that they want to implement, they can make that change immediately by importing it directly to the itinerary. This tool saves a lot of hassle trying to change individual components and allows the planner to develop an all-encompassing solution.

d. *Analytical and Predictive Queries*

The Intellijet II system has consolidated twenty; previously separate applications while enabling all of the data in these applications to be shared throughout the new system. It allows planners to use analytic tools to compare predictive and historical booking patterns, as well as geographic patterns, to help prepare for demand (Picarille, 2004). Since NetJets has a much larger number of customers than aircraft, there will be times when customer requests will overwhelm the NetJets ability to supply enough crews and aircraft to meet demand. Using the data from past years' requests, planners are able to accurately predict what travel dates have the highest demand. This data enables planners to put additional aircraft in a specific region or assign additional crews to be on call during these peak travel periods (Ebiz, 2003). The system can also accommodate multiple requests if an event, such as a golf tournament or a conference in a certain geographical area, by arranging additional resources to be in place, preventing the need to charter outside aircraft to fulfill nonevent related requests in that region. By using the system to analyze these predictive spikes in demand, NetJets is able to better serve the customer in the most efficient way.

4.   Infrastructure Development Challenges and Solutions

The first Intellijet system was designed in 1992 by an internal software development team covering some basic features, matching the size of the system to the size of the company. As the company grew, the operations growth outpaced the systems capability, and the development team decided to develop a new system from within the company, since there was nothing available off the shelf to handle their unique operations. Intellijet I had turned into a system of multiple stovepipes that had limited interoperability between applications.

a.   *Architecture*

When Intellijet II was first proposed, the development team had a very good idea of what features they needed from the owners' services department and other user inputs. The piece they lacked was a sound architecture to bring together the information from across the enterprise. The team went to Persistence software to develop the needed data services architecture that could provide the requisite infrastructure to make the new system function. The main purpose for redesigning the system was to increase customer relationship management and create a truly customer-centric way of conducting business. Persistence's CEO Chris Keene said, "Persistence Software's Data Services architecture gave NetJets a way to begin with a complete view of its customers and build all of its operational applications on top of that" (Persistence, 2003).

b.   *Development Process*

The key features and efficiencies created by Intellijet II are the outcome of a well-planned development process. NetJets wanted to ensure this system could meet its future expansion needs. Speaking about the development phase that took place, NetJets CIO Mike Midkiff said, "We quickly realized that developing a truly customer-centric system would pose three significant technical challenges. It has to support a complex data model for customer profile and schedule data. It needs to run very fast to maintain a reliable real-time latency. It needs to scale cost-effectively to multiple locations"

(Picarille, 2004). The Intellijet II system needs to address the demands of continued growth and increased customer service in a very dynamic business (Persistence, 2003).

           (1)   <u>Computing Capability</u>: The first challenge NetJets faced was to, support a complex data model. A crucial part of the system's foundation was to create a system that can implement knowledge and manage information. The system needs to have significant computing capability in order to manage the thousands of variables from aircraft characteristics to customer profiles, along with NetJets operating rules and optimization processes. This capability needed to be available to users connected by various devices, including the pilots' Blackberry and the operations center's master display systems. To address this challenge, NetJets decided to provide a single uniform, platform neutral data service for any application platform such as Java, C++ or .NET (Persistence, 2003). This data service gives NetJets the ability to choose the right platform for a specific application, without having to adjust the entire system.

           (2)   <u>Real-Time Synchronization</u>: The next challenge was to create a system with reliable real-time synchronization. This synchronization was crucial for the system's requirement to operate in such a dynamic environment. Without this attribute the system would be useless in coordinating between functional areas and adapting quickly to customer demands. In order to meet this challenge, NetJets implemented Persistence software's data services architecture as the platform for more than twenty application modules of Intellijet II (Ebiz, 2003). The architecture manages the distributed data problem by integrating, distributing and synchronizing time sensitive data from many data sources to many applications or locations. The part of the architecture that enables this data availability is the virtual data management layer. It is referred to as data services, and lies between the system's applications and data sources; as seen below in Figure 9.

Figure 10.   Intellijet II Data Services Architecture (From Persistence, 2003)
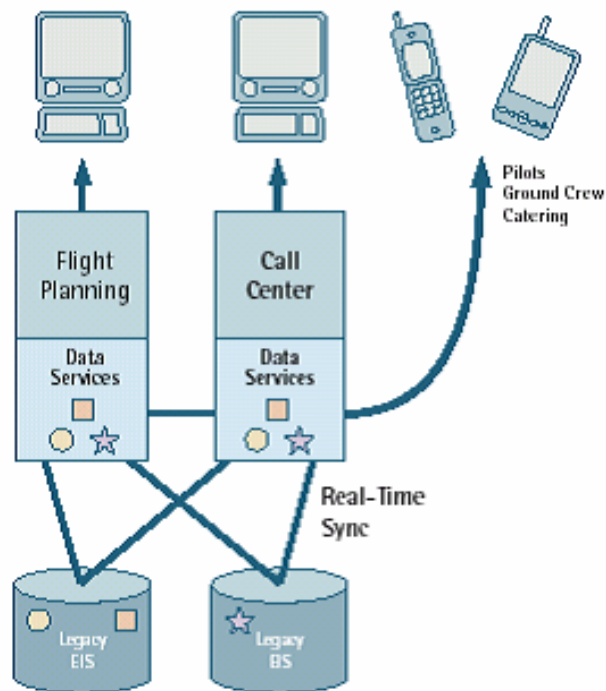
The data services within this layer provide utilities to integrate, cache, distribute, synchronize and provide rule based data alerts. Anytime an application changes the data stored in the data source, this layer alerts all other applications that are linked, or are using the data, that a change has occurred and it needs to check its validity within its functional area.   For example, pilots, ground crews and caterers receive automatic notifications and request responses driven by the data services layer when a flight schedule changes.

(3).   Scalability: The third challenge in creating a new system was to scale the system, cost effectively, to multiple locations. Due to the dispersed operations of the company around the world, along with rapid growth into new markets in Europe and Asia, system users need to be able to interact with the system remotely. The users of the system vary from customers to flight crews en-route and multiple base locations. Being able to scale the system to match the rise in growth of both customers and the aircraft, along with its supporting personnel, is a critical attribute. In order to serve 500 users, NetJets uses four Dell 2650s with dual Zeon processors, and currently

have 1000 users within the company (Persistence, 2003). These components provide the cost effective scalability that is nearly linear when adding on additional users and servers.

5.   Summary

The fundamental advantage of Intellijet II is that every employee has a complete and up-to-date view of the customer and schedule (Persistence, 2003). Using this common operating view, operations can be planned and conducted in a near optimal way which increases customer satisfaction in the end. Since the customers are part owners, CRM is critical for keeping customer turnover low and the fleet of aircraft large enough to operate efficiently. Proof of this successful operating view is evident by NetJets being the only profitable fractional operator in 2002, with the largest fleet of any operator (Velocci, 2003). To help compare and contrast in later chapters Intellijet II with the JALIS system, Table 2 summarizes some of the main features of the Intellijet II system.

Table 2.   Intellijet II System Features

Real Time System Synchronization
Itinerary Feasibility Engine
Data Alerts: pushes and pulls updates from system to the user and back
Constant Itinerary Problem Check
Scenario Planner
Platform Neutral Data Services / Virtual Data Layer
Analytical and Predictive Queries
Optimization Scheduler
Integrated Supplier Services
Interactive Task List

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IV. JOINT OPERATIONAL SUPPORT AIRLIFT CENTER

This chapter outlines the Joint Operational Support Airlift Center's (JOSAC) operations and how JALIS, the scheduling system functions. This section defines the users, their interactions with the system, and an outline of what the system provides them. In addition to the system's background, this chapter will outline the crucial features of JALIS for JOSAC's operation. A hypothetical flight and how the system fits into the process will be used to illustrate these features. User identified shortfalls of the system will also be recognized. The information contained in this chapter was gathered from the JALIS training manual, along with interviews of JOSAC members, LCDR Thomas Stevens, OIC for JALIS, Mr. Michael Day, Chief JALIS Instructor and Mr. Dave Wiley, Deputy OIC for Scheduling.

A. JOSAC CONCEPT OF OPERATIONS

JOSAC is tasked with effective and efficient use of available Continental United States (CONUS) based Operational Support Airlift (OSA) assets to support the highest priority Department of Defense (DoD) customer requests for travel. This task is completed by programming, planning, scheduling, modifying, executing, and tracking CONUS OSA missions. The OSA system currently provides essential wartime readiness training to aircrews, while fulfilling essential DoD airlift requirements that cannot be satisfied by other air travel. Approximately 25-30% of allocated flight hours are dedicated to air crew training without passengers. The rest are used by JOSAC to meet airlift requests.

The current worldwide OSA fleet consists of approximately 375 aircraft made up of 14 different types. Of the 375, about 254 aircraft of 10 types are assigned to CONUS OSA flying units. These 254 aircraft are located at 85 different Active, Reserve, and National Guard CONUS operating locations as seen in Figure 11.

Figure 11.   CONUS based OSA aircraft locations (After JOSAC, 2003)

For many years the separate Services were responsible for their own OSA missions. Each Service owned, operated and scheduled its own assets. They provided airlift only to their own Service's customers with their respective Service's aircraft. There was very little, coordination between Services, and they did not utilize each other's assets to create efficiency. Each service has a few specialty aircraft however in many circumstances; the Services did not effectively manage their aircraft. The aircraft were either larger than necessary or could not meet the Services needs, while another Service's aircraft could have, been used to better address the customer's needs.

Figure 12 lists aircraft ranging in size from a six passenger turbo-prop C-12 to an airliner C-9. Due to a limited selection of the type of aircraft available, the Services took care of their most critical air travel requests, leaving many others unfulfilled.   The challenge for any scheduler, no matter the Service, is to have the right size aircraft available at the right place at the right time. The scheduler needs to arrange for an available aircraft, a trained crew, and programmed flying hours to accomplish the mission. Not only was this Service isolated operation limiting, it was far from being efficient.

Figure 12.   Breakdown of OSA aircraft by service and type (After JOSAC, 2003)

TYPE	USA	USN	USAF	USMC	TOTAL
C-12	81	22	0	13	116
C-21	0	0	52	0	52
UC-35	10	0	0	4	14
C-38	0	0	2	0	2
C-9	0	23	0	2	25
C-20	0	2	0	0	2
C-22	0	0	2	0	2
C-23	30	0	0	0	30
C-26	9	0	0	0	9
C-40	0	0	2	0	2
TOTAL	130	47	58	19	254

As a result of these inefficiencies, the Chairman of the Joint Chiefs of Staff (CJCS) commissioned a study on Service airlift and made the following recommendations:

- Reduce flying hours to the number required to accomplish essential flight crew training and to maintain aircrew proficiency.
- Consolidate OSA scheduling for all the Services under a single commander.
- Continue multi-Service ownership of OSA assets.

Starting in 1995, the scheduling of OSA assets was coordinated between Services and finally became the responsibility of the newly formed JOSAC, providing DoD wide scheduling. Today, JOSAC handles the scheduling of OSA assets, but are limited to what assets the Services provide them. Each Service has their own way of handling airlift requests from their personnel and coordinating what assets are available to JOSAC to schedule.

Operational Support Airlift Agency (OSAA) is responsible for coordinating and scheduling the Army's Regional Flight Centers, and for managing 49 state flight detachments across CONUS and Alaska. In February 1997, Army CONUS OSA

scheduling became the responsibility of the JOSAC. The Operational Support Airlift Command is the single point of airlift request verification for the Army.

The CONUS US Navy OSA schedules have been developed at the Naval Air Logistics Office (NALO) in New Orleans, LA. NALO remains the single point of airlift request validation and verification for the Navy.

All scheduling activities for Marine OSA missions were assumed by JOSAC in 1996. They use four points of validation for their customer's requests: an east coast location, a west coast location, a reserve location, and HQ USMC.

Air Force CONUS OSA scheduling became the responsibility of the JOSAC in 1996, while their OSA assets went under the control of Air Mobility Command in April 1997. The Air Force has request validators at Major Commands, the Air Staff, and some specific Numbered Air Forces (JOSAC 2003).

In fiscal year 2002 JOSAC had the following performance statistics (JOSAC, 2003):

- 36,204 Requests filled
- 73,561 Sorties on 16,415 Missions
- 230,678 DoD Passengers
- 19,111 Senior Government Passengers to include 133 Senators or Congressmen
- 6,819 Space Available Passengers
- 2,515,420 lbs of Cargo

For every mission JOSAC assigns to a flight crew they are filling multiple requests involving several sorties. While the number of flights JOSAC schedules, 73,561, is less than a third of NetJets' 250,000 flights per year, they share the same principles and strategies in managing their operations. With a fleet of 512 aircraft NetJets is able to fill 250,000 customer requests, where as JOSAC is only able to fulfill 36,204 requests with half the aircraft. While JOSAC does not have total control over

their aircraft and flight crew availability, there is still room for improvement in asset scheduling and utilization

B.   JOSAC MISSION

JOSAC's mission statement reads;

JOSAC performs consolidated scheduling of CONUS based operational support aircraft, achieving wartime readiness by supporting the highest priority peacetime DoD missions. This high performance joint service team provides timely and flexible service through enhanced customer relations (JOSAC, 2003).

JOSAC   carries   out   their   mission   by   programming, requesting/validating/verifying, planning, scheduling, modifying, executing, and tracking CONUS   OSA   missions.   The   scheduling   process   starts   with   the   customer (requester/traveler) submitting to their Service validator a request for airlift.   The validator enters the request into JALIS and assigns the Priority, Urgency, Justification, and Category (PUJC) to the request. Based on the priority of the request the schedulers at JOSAC match the unsatisfied request and available assets to make the most effective and efficient missions possible. If the request cannot be scheduled, it is denied and that information is posted into JALIS. The validator notifies the requester of non-support. If the request is accepted and scheduled on a mission, then the validator is notified through JALIS and they, in turn notify the requester. The unit assigned to fly the mission is also notified through JALIS of the tasking. The assigned flying unit then coordinates directly with the travelers to close the loop and arrange the final details. The final step in the process is the post mission reporting done by the flying units. These aspects of their mission are outlined in the following section.

1.   Programming

At the beginning of each fiscal year, the Services allocate annual flying hours for each OSA mission/design/series (M/D/S) aircraft. Each Service bases these allocations on historical data in order to project and plan the amount of flight hours for each M/D/S aircraft supporting the OSA mission. This review allows the Service to break down

flying hours to quarterly, monthly, and weekly requirements that will be divided amongst flying units, which are then provided to JOSAC for scheduling.

2. Requesting/Validating/Verifying

When a potential customer wants to travel using an OSA aircraft, they fill out a request with their Service's validator. Then, all customer requests flow from Service validators/verifiers to JOSAC via JALIS. The validating authority for each service reviews the request and verifies the details to ensure the customer meets the criteria for special airlift. Each valid request is assigned PUJC codes in order to rank the requests. Only Service validated/verified requests will be entered into the JOSAC JALIS system. This helps filter only the most legitimate requests and simplifies the scheduling process. This entire process is currently done manually by multiple validators. Because of the large volume of requests JOSAC does not have enough dedicated personnel to process all of the potential requests. These validators, while performing a function for JOSAC, could be considered as an outside supplier for JOSAC since they do not fall under JOSAC's command. They are similar to what catering, and ground transportation companies do for NetJets as a supporting agency.

3. Planning

JOSAC plans OSA missions based on available assets, valid requests, and the indicated PUJC codes for the request. This plan is done in JALIS by the schedulers for the day of the request. This process is done manually utilizing the scheduler's knowledge and using JALIS as a tool to store plan details.

4. Scheduling

JOSAC uses five scheduling teams, each responsible for a specified day of the week, with one team scheduling Saturday, Sunday and Monday. Each team is made up of about four schedulers. The team works with all the requests for that day, typically between 30-35 requests, sorting out the assets available and assigning them to the highest priority missions. In order to efficiently use available airlift assets and avoid last minute

changes, JOSAC uses a three-phase mission scheduling process: standard, modification, and alert/execution.

5.   Standard Schedule

Standard schedules are completed by JOSAC scheduling teams in accordance with JOSAC standard operating procedures. The schedules for large airlifts, 9 or more passengers, are done on D-10 (ten days before execution). The small airlifts, fewer than 9 passengers, are scheduled on D-4. All requests will receive a "yes" or "no" answer from JOSAC no later than D-4 for small aircraft and D-10 for large aircraft (JOSAC, 2003). It is at this point that assets are dedicated to specific requests.

6.   Modification

Changes to a planned mission can occur at anytime due to aircraft maintenance problems, customer schedule changes or to improve operational efficiency. Should a change occur after a mission has been scheduled, it falls under the modification phase. The usual cause for a change in this phase is induced by the customer. JOSAC will determine if the modification can be accommodated without disrupting other priority missions and communicate a "yes" or "no" answer to the validator and customer. Occasionally changes caused by aircraft availability from maintenance or other urgent requests will cause a customer's request to be cancelled, but this rarely occurs. Because JOSAC is charged with efficiently using airlift they will modify the standard schedule if greater benefit can be realized without effecting currently obligated requests.   Once priority is determined, changes to the standard schedule will be avoided unless circumstances dictate an urgent need.

7.   Alert/Execution and Tracking

JOSAC will alert aircrews on where to meet passengers and provide them with the passenger's contact information if changes do occur to allow them to coordinate on site. JOSAC tracks the progress of all CONUS OSA missions. Through the use of several different systems: these systems are the Federal Aviation Administration (FAA)

Enhanced Traffic Management System (ETMS), JALIS and telephone contact. They enable timely reaction to priority changes, even as missions are underway. ETMS allows JOSAC to use the FAA's flight tracking to monitor all the flights as they are in flight, enabling JOSAC to update an aircraft's time of arrival and coordinate any changes caused by weather or traffic delays. They maintain a list of what flights are currently in progress and what is coming up using JALIS. To coordinate most last minute changes they will use the telephone to reach those parties affected.

C.   STAKEHOLDERS ROLES

This section defines each stakeholder's role in delivering airlift to the customers in the most efficient way.

1.   JOSAC's Role

JOSAC is responsible for tasking OSA flying units from all the Services to meet standard, supplemental, and alert requirements for airlift. JOSAC notifies customers via JALIS as soon as possible of supported or unsupported requests. All CONUS OSA passenger and cargo carrying missions are scheduled, executed, and monitored by JOSAC. US Transportation Command (TRANSCOM), through JOSAC, maintains command and control (C2) of these operations from take off to landing. JOSAC must be prepared to redirect and modify the missions, coordinating with all stakeholders on a moments notice. This is critical if supplemental or alert missions are needed to meet an urgent demand that was not on the standard schedule. The JOSAC Duty Officer, execution team, and the scheduling team that originated the mission must maintain visibility over the mission from departure to termination.

2.   Service's Role

Each Service allocates actual monthly flying hours to the flying units that fall under the Service's responsibility. Each Service is responsible for determining what agency accomplishes the validation of OSA requests that come from personnel within their command. A Service designated agency will respond to all aircraft emergencies

encountered while supporting OSA missions, however the final responsibility for the security and safety of each flight lies with the Aircraft Commander. Service validators will inform JOSAC of any required mission changes. This allows JOSAC to provide support for any affected passengers.

3. Flying Unit's Role

Each OSA flying unit receives its taskings from JOSAC by either telephone or electronically in JALIS. The flying units are responsible for selecting and generating a specific number of aircraft and crews to support JOSAC scheduled taskings. Although the specific identifying tail number of the assigned aircraft is required in JALIS, the flying unit's focus is to provide the aircraft type in order to fill the request. Flight crews contact JOSAC with any issue involving changes to the printed schedule or customer support. Units can be tasked to stand alert when needed by JOSAC. In order for the schedulers to effectively and efficiently task flying units, the squadrons must properly update aircraft availability in JALIS. The units must know how to retrieve their taskings and execute the mission. The last step is to report mission results to ensure the JALIS database is current for future tasks and accurate reports. After each mission the units are responsible for completing post mission reporting requirements, Logistic Flight Record (LFR) and Aviation Exception Report (AER), in a complete and timely manner.

4. Requester and Validator Role

The requesters are responsible for submitting complete, accurate, approved requests to their Service designated validators using the prescribed DoD format. The validators need to ensure requests are properly entered into JALIS with a PUJC code to allow JOSAC to schedule Service aircraft. Validators are also the liaisons who keep the requester/travelers informed of the status of their requests. As soon as requesters determine they no longer require support, they should immediately cancel the request.

D.   JOSAC MEASURES AND METRICS

The following categories are used by JOSAC to measure their effectiveness as an organization. These categories were a result of a challenge by the Secretary of Defense wanting to improve operations throughout all OSA missions.

1.   Customer Satisfaction: Traveler vs. Trainer

In wartime or national emergency, the traveler is the primary customer. However, during peacetime when non-emergency OSA is operating, the primary customers are the crews in training. This change is to ensure that the air crews are receiving the required amount of operational training to stay current in flying their major weapons system. Since the traveler is not the primary customer this creates the occasional difficulty for JOSAC to produce a schedule of operations that meets the largest number of traveler requests and operate efficiently.

2.   Operational Effectiveness

Operational effectiveness is measured by determining if the customer traveled to their desired destination at the promised time. The metrics used include percentage of requests filled for each category level, mission filled within promised time and proximity to the customer's final destination.

3.   Operational Efficiency

Efficiency can be looked at as filling the maximum number of seats possible while flying the shortest possible route to fill those seats. The most efficient route may not be the proverbial straight line or the most effective. Creating efficiency has not always been a priority for most parties involved in flight scheduling and execution. As long as the highest priority missions were filled, JOSAC could claim the mission had been completed, although not in the most efficient way. To achieve a high level of operational efficiency requires flexibility. This level of flexibility involves inconvenient mission assignments, which may require extra funding from flying units or other

organizations that may not have anything to gain. But this is necessary to achieve an overall more efficient end product.

4.   Accountability

In the past, OSA assets have used in ways that were not always in the taxpayers' best interest. This became apparent after the 1995 CJCS study on the usage of OSA assets. This recommended that the OSA mission be accomplished in the most cost efficient way possible. Every effort should be made to minimize the military air costs associated with official DoD travel requests. Therefore, the type of aircraft used shall be based on minimum cost and size necessary to satisfy the mission requirement. The aircraft shall not be assigned to an individual on the basis of grade, rank, or position unless specified by the Secretary of Defense as required use. In order to keep abuse of the system down, all unit aircraft shall not be used to transport DoD passengers and cargo unless they have been properly requested following the rules set in DoD Directive 4500.43.

E.   JOINT AIR LOGISTICS INFORMATION SYSTEM

The purpose of JALIS is to provide centralized on-demand air logistics requesting, planning, scheduling, and messaging for joint Services OSA. It also provides historical airlift data and limited reporting capabilities. The JALIS system operates at three CONUS locations where its infrastructure is maintained: NALO, New Orleans, LA; USTRANSCOM, Scott AFB, IL; OSAA, Fort Belvoir, VA. Details of this system are provided in the following sections.

1.   System Components

JALIS is a centralized, multi-user, menu-driven information system using relational database management technology. Oracle was chosen for the system because of its portability between environments, enabling JALIS to run on a number of different platforms. The JALIS application uses Metaframe system software for thin-client server computing. JALIS is installed on a multi-processor UNIX operating system. It has been established as the DoD standard for on-demand logistics, airlift scheduling and

consolidation of historical airlift data. JALIS replaced the Naval Air Logistics Information System (NALIS), which had been adapted to meet the needs of the joint environment. The JALIS system is based on 1980's technology and has undergone several upgrades to keep it operating today (JOSAC, 2003).

In order for users to establish a connection to one of the three JALIS servers they can use a modem session, a Telecommunications Network (TELNET) session or using the Citrix Client over the internet. The software used to access JALIS is Citrix WinFrame. This thin client application software executes entirely on the JALIS server and only updates the users screen. The WinFrame software was chosen because of its capability to centrally deploy applications across heterogeneous computing environments for users with a wide range of hardware, operating platforms, and network connections.

Security is maintained using a standard user identification and password, with defined password crack standards and different user permissions. In addition, regular system scans are done to look for intruders or corrupt accounts. The Terminal Area Security Officer is a JALIS specific term for the security person associated with JALIS.

The following groups are the typical JALIS users and are the basis for the different user permissions in the system.

- **System Administration** - has full permission for the system and assigns other users permissions. They address other users' technical problems and assist with database features. They also build, back up and maintain the database.

- **Scheduler** - have the capability to create, review, and modify any data associated with airlift schedules.

- **Requester** - have permissions for maintaining passenger files; creating, maintaining, and reviewing airlift requests; displaying flight advisories; displaying mission itineraries; and entering proposed plans for flight routes.

- **Squadron user** - permissions are associated with data about the actual aircraft and the missions they perform. Their permissions ensure the aircraft, aircrew, and flight hour information is accurate and post mission reporting is accomplished.

- **Validator** - has a mixed view which shows them what the requester can see, along with JOSAC's scheduling teams' decisions and flying unit assignments.

2.   System Features

JALIS is a database, not a mission scheduler. It contains many pieces of information that are required to schedule a JOSAC mission. The JALIS database is where the schedulers build missions and link airlift requests to those missions. JALIS has asset information about aircraft, their location, their availability, flying hours, crews, configurations, etc. The database also contains passenger lists, airlift requests, distances between airports, flying times, flight records, telephone lists, message information and addressees. The following system features are grouped by the user and explain how they contribute to accomplishing the mission.

a.   *Flying Unit Features*

JOSAC uses the following applications to notify flying units of specific mission taskings via Flight Advisory Messages in JALIS along with fulfilling post mission reporting. Last minute changes and additions are still handled by a telephone call.

(1)   <u>Current Scheduled Missions View</u> When a squadron user has connected to the system they have the option to view all of the unit's current scheduled missions. It will show all of the scheduled missions, provided that a Flight Advisory Message has been generated, released and sent; and the mission has not been cancelled or closed out.

(2)   <u>Flight Advisory Message</u> This message provides pertinent information regarding the mission. Passenger request information, schedule information, and certain reference files are combined to create a JALIS-generated Flight Advisory Message.   The scheduler responsible for the mission must ensure the message is complete, correct, coordinated, and sent to all stakeholders. This is the process for alerting, changing and updating users up to 72 hours before the mission.

(3)   Post Mission Reporting Post mission reporting involves entering the LFR and the AER into JALIS. There is a dual responsibility concerning these reports. The crew is responsible for the information, while the unit is responsible for inputting the information into JALIS. This feature allows JOSAC to track all usage and build a history of all operations and their details. It also helps the schedulers know when assets will be next available once a flight has been completed.

(4)   Squadron Information Modules The Squadron Information modules allow the database administrator or squadron user to enter and provide essential information necessary to complete the OSA mission. The Squadron Hours Maintenance module is used to restrict aircraft when the hours designated for each individual aircraft have been used up. The Flight Personnel Maintenance module allows the squadron user to maintain a list of flight crew personnel, from which mission crews can be selected.

b.   Scheduler Features

In order to achieve the highest level of mission effectiveness JOSAC's schedulers need to have active two-way communication with all stakeholders involved. With this communication they need to provide a high level of responsiveness to those stakeholders who rely on the scheduler's decisions. They have end to end responsibility for each of their daily missions and they must be able to coordinate all the details using the JALIS system. The schedulers require a high level of knowledge to complete their job, and the current system is one tool they use.

(1)   Request Sorting This feature allows the scheduler for a particular day to see exactly what requests have been received in order to monitor that day's expected missions. These requests can be sorted by priority and other criteria to help address the most critical requests first. By categorizing the requests keeps the request process is more organized and simplifies the planning phase.

(2)   Consolidated Data Channel Having the JALIS system as the main source of all OSA mission data presents a way to ensure all stakeholders can see the most up to date information. Schedulers can match available aircraft with requests

more easily, and also get updated aircraft status if assets become unavailable. Requestors can get a response faster on whether their airlift was supported. The involved flying unit is alerted on what is expected all at the same time. JALIS also helps coordinate between scheduling teams who may have to coordinate between days due to overnight trips, or changes to the date that shift the trips responsibility.

(3)   <u>Consolidated Flight Scheduling Details</u> Having one source for aircraft details and itinerary characteristics allows the schedulers to match requests with the right type of asset to best serve their needs. Along with aircraft details are airport details such as operating hours, available fuel or customs services, runway length and proximity airports location. This database of scheduling information tries to give each scheduler a common source to get the details necessary to schedule missions.

(4)   <u>Joint Operational Support Airlift Aid to Mission Scheduling (JOSAAMS)</u> JOSAAMS is a separate component from JALIS, and is a tool used by the schedulers to show potential opportunities to fill an unfilled request. The scheduler will display the flights departing during a certain timeframe, along with the flights direction and passenger load. They will then display the flights they are trying to fill attempting to combine passenger loads for filled missions and unfilled missions. This visual presentation showing the map of the United States with these flight routes allows JOSAC to fill some additional unfilled requests. The view the scheduler has can be seen in Figure 13.

Figure 13.   JOSAAMS Visual Display of All Proposed Flights (After JOSAC, 2003)
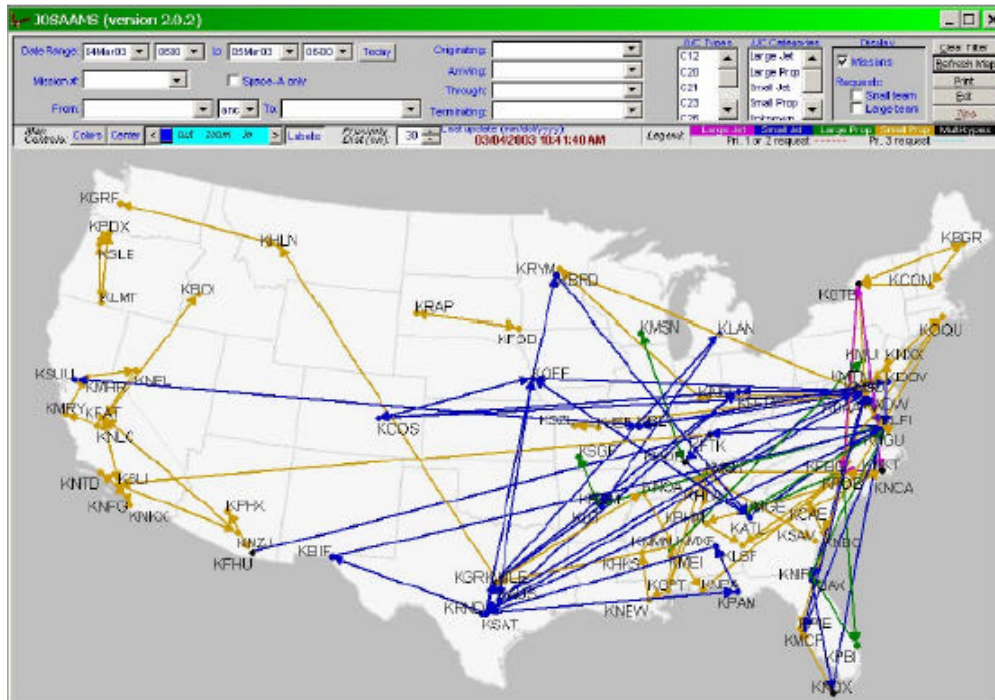
JOSAAMS can filter the presentation to show only a selected day or even only a portion of a day. It can also filter the missions by specific aircraft type or by a grouping of aircraft, such as small jets. JOSAAMS can also filter the requests by large or small aircraft size. The scheduler looks for routes that run parallel and investigate factors such as direction of flight, available seats or cargo capacity, and flight times. If missions can be consolidated the scheduler goes into JALIS and modifies the mission to add the airlift, thus creating a more effective and efficient mission.

Table 3 outlines JALIS's key features.

Table 3.   JALIS System Features

Single Data Source for All Transactions
Request Sorting
Flight Advisory Messaging (only automated process)
Common Asset Detail Bank
Proposed Scenario Planner
Thin Client/ Server Topology
Post Mission Reporting / Past Operations Reports
JOSAAMS (Scheduling)
Uniform Communication Between Stakeholders
EMTS Integration

F.   JOSAC SHORTFALLS

1.   Operational Shortfalls

While JOSAC's current operation is a large improvement over what the separate Services were able to accomplish individually, there is a lot of room for improvement. This section identifies the shortfalls of their current operations.

a.   *Request Validation Process-Balancing Supply and Demand*

The first shortfall lies in the request and validation process. There is conflict between what the validators need compared to what the schedulers need. The validator is verifying that a customer request meets the rules put out by JOSAC to

distinguish between different priorities and needs. But since the validator works for the individual service or department they want to please the requestor and do their best to get their request filled. The scheduler also wants to fill as many requests as possible but usually does not have the assets available to do so. They would like the validator to be more stringent in the types of requests they pass on to be scheduled making the scheduling process simpler. Because there are more validators forwarding requests to a smaller group of schedulers, the schedulers have the extra task of sorting out the numerous requests along with last minute additions. There is a need to better filter these requests, either by sorting by time entered, requiring the validators to more thoroughly process each request or introduce a feedback system to make the validator more responsible.

b. *Aircraft Availability*

The next operational shortfall lies outside of JOSAC's control but limits JOSAC's scheduling capabilities. Since JOSAC does not have control over the aircraft assets and crews, uncertainty regarding schedule availability is increased. They can only schedule the assets they are provided from the flying units, which are in constant flux. The flying units that support JOSAC have 25-30% of their flying hours dedicated to training only. Occasionally aircraft that are scheduled for training or down for maintenance will incorrectly appear as being available to JOSAC. This is due to the flying units' failure to provide the most up-to-date asset availability, which causes a request to get falsely filled. A common cause of this is because the flying unit's maintenance and scheduling team has to use two different systems to operate, JALIS and their own information system. This requires duplicate entries and when under pressure and only one system gets the most current status, the local system usually takes priority over JALIS.

b. *Flight Crew Availability*

Similar to JOSAC's lack of control over the aircraft and flight crews, a conflict of interests between JOSAC and the flying units occurs. Flight crews rarely stay overnight with an aircraft, even if it could save large amounts on flight costs. The reason

this occurs is because Temporary Duty per diem and other expenses are paid for by the flying unit and not JOSAC. This misalignment of JOSAC's mission with the flying unit's budget costs the DoD large amounts in wasted resources. While occasionally the flying unit will agree to keep a crew overnight, it is only in extremely evident circumstances. This lack of resource utilization makes JOSAC's job more difficult by eliminating many potential opportunities to improve operational efficiencies but ends up leaving an unknown amount of requests unsatisfied.

2. JALIS Shortfalls

The following shortfalls, ranging from small system glitches to system wide problems, were identified by various JALIS users.

a. *Lack of Real Time Data*

The data is not quite real time and lacks reliability of being updated in time for others to see it. This shortfall prevents the system's ability to deliver updated information to the right people in time for it to be useful. For example, schedulers have difficulty keeping up with the assets they have to work with, along with projecting when aircraft will be down for maintenance. Then, when schedulers deal with last minute changes, the system is difficult to modify to make the required adjustments.

b. *Not User Friendly*

The system is not user friendly, and is inconvenient for certain groups to use, such as the flying units and requesters. User incompatibility prevents flying unit users from incorporating it into their operations and aligning all users in the same system. The operations department and flying unit's inconsistent use leads to the lack of quality information being disseminated throughout JALIS. The system has too many disconnected modules, making it difficult to accomplish tasks. Changing a minor detail of an itinerary requires an extensive process. Two of the details most often used when scheduling itineraries, aircraft characteristics and proximity airport distance, are not included in the system and have to be dealt with manually each mission. Another

undesirable aspect of the system is the presence of unfilled flight requests. There is not a mechanism to remove these requests in a timely manner, so they remain in the system until the time of flight request, cluttering the scheduled requests.

c. *System Instability*

The system's infrastructure is also a cause of sub par capability. Since the system was adapted from the 1980's NALIS technology, it has gone through several modifications to keep the system operating. Instability from adding features on top of an old system has been a constant problem. A common example is when an itinerary is being generated and a minor fault in a certain field causes the system to crash, the entire proposed itinerary is lost. The system is not a true web based system; it only has a way to access the database using the internet, which adds another layer of potential trouble. The current system is not DoD compliant with regards to the IPS CAC certification. Finally, the database is set up in a very inefficient manner. A single change to an itinerary causes long code scripts, which take up excessively large amounts of data storage.

G. SUMMARY

The mission of JOSAC is to have a single scheduling and coordination source for OSA operations in a timely and flexible manner. , JOSAC is able to align the scheduling system with JOSAC's operations by using the JALIS database, having a single data source for all of the organization's interactions. This single source makes JALIS streamlined for the schedulers, better serving the customers by meeting more of their requests. However, we have seen that not all of the users have aligned objectives, which sometimes contradicts one another. Along with this misalignment of priorities, other shortfalls such as the systems usability and infrastructure remain a problem. The features that help manage the various assets, from aircraft to personnel, allow the system to function, but in a manner that is far from being timely and flexible to the extent that it could be. The actions of JOSAC are very deliberate and could be improved to better manage the dynamic environment in which they operate.

V.   ANALYSIS AND RECOMMENDATIONS

This chapter brings together the previous evaluations of NetJets, microjet travel operations and JOSAC's operations in order to identify key differences between them. This chapter analyzes how to improve JOSAC's shortfalls and make recommendations for the entire operation. The focus of this analysis answers the question of how NetJets' Intellijet II system, along with microjets, can improve JOSAC's operations.

A.   CRITICAL DIFFERENCES

Before proposing features or making recommendations on a new system, several differences between NetJets and JOSAC need to be clarified. While these systems both specialize in scheduling passengers for personal aircraft travel, each organization has different goals and ways to achieve those goals. NetJets is a profit driven company, committed to serving its customers. JOSAC's goal is to fulfill a mission with limited resources and dual customers, both the requesting passengers and the flying squadrons. Furthermore, the resources JOSAC has to work with are determined by the Services' budgets for flying units. Despite some coordination with the Services, JOSAC is much more constrained in its operations than NetJets. This constraint arises from the conflict between JOSAC's mission and the flying unit's mission is preventing each user from attaining the highest level of operational effectiveness.

When dealing with customers, both NetJets and JOSAC strive to meet the customer's needs in the best way possible. NetJets has been rated best in their industry for customer service by making it their top priority, meeting nearly every customer demands no matter the cost. JOSAC tries to meet every customer's demand, but has to deal with denial of service because there are continually more customer requests than there are available assets. NetJets is flexible with the resources they have available in meeting the customer demand. For example, they can mix and match crewmembers to create efficiencies because of how they schedule pilots, seven days on then seven days off. This affords NetJets the luxury of knowing crew availability long in advance, being able to assign that specific crew to any flight within that period to meet changing

demand. JOSAC is limited by the way the squadron schedules the crew. In many cases, The flying unit scheduler limits the mission to a single day making the aircraft and flight crews unavailable to be used in an on-demand manner.

B.   JOSAC RECOMMENDATIONS

This section proposes the steps that JOSAC could take to improve their operational effectiveness. Recommendations will be made specifically for the Decision Support System, operational strategies and incorporating future aviation technologies.

1.   Decision Support Scheduling System

Table 4 lists DSS System Attributes matched with the features of Intellijet II compared to JALIS for analysis of these systems. The following sections expand on each DSS system attribute and make recommendations for a proposed JOSAC DSS.

Table 4.   Comparison of DSS System Attributes of Intellijet II and JALIS

DSS System Attributes	Intellijet II	JALIS
Information Availability	Real Time System Synchronization	Single Data Source for All Transactions
Infrastructure	Platform Neutral Data Services / Virtual Data Layer	Thin Client/ Server Topology
Reservation/Request Validation	Itinerary Feasibility Engine	Request Sorting
System Knowledge	Constant Itinerary Problem Check	Common Asset Detail Bank
Support Agency Integration	Integrated Supplier Services	Uniform Communication Between Stakeholders
Efficient Scheduling Solutions	Optimization Scheduler	JOSAAMS (Scheduling)
Forecast Simulation	Scenario Planner	Proposed Scenario Planner
User Interaction and Communication	Data Alerts and Responses	Flight Advisory Messaging
Reporting	Analytical and Predictive Queries	Post Mission Reporting / Past Operations Reports
Accountability	Interactive Task List	EMTS Integration

a. *Information Availability and Infrastructure*

Intellijet II operates as a real-time, self synchronizing system to maximize information availability; JOSAC needs to incorporate this into their system. Utilizing a platform neutral data services architecture, similar to the one designed by Persistence software for Intellijet II, would allow the data to be accessible to the right person in time for it to be useful. JOSAC would be able to operate more efficiently, filling more flights within the 72 hours of the scheduled flight time, allowing them the flexibility to easily make on-demand adjustments within their dynamic environment. Along with this improved information availability exists the need for increased information reliability. The JOSAC system needs to incorporate redundant systems throughout its infrastructure to minimize system down time or prevent the loss of critical mission data if a malfunction or system error occurs. Utilizing a virtual data layer that has back up data storage systems in different locations provides the necessary means to keep operations running whenever a problem is encountered. Using this architecture has the potential to decrease infrastructure maintenance costs by nearly 40 % similar to what NetJets realized with Intellijet II, along with greater efficiency in all aspects.

b. *Reservation/Request Validation*

The request application needs to allow the customer to easily interact with their Service's validator, allowing them to submit requests and check the status of their request online. JOSAC has looked at incorporating a request module that is similar to the one used by Air Mobility Command called Consolidated Air Mobility Planning System (CAMPS), designed by Northrop Grumman. Simplifying this process and enabling the user serve themselves allows them to take on the workload, saving the validators and schedulers time and effort.

The validator applications could mimic that of a reservation agent in the Intellijet system. Giving validators applications like the Itinerary feasibility engine could provide immediate feedback to the requestor on the best airport to fly into, if the requested time period is available, and give the requester a best case estimate of their request being executed. Another part of this application should use stringent filters for

the requests, allowing only those requests that meet the preset requirements and putting the validator on the spot to back up their judgment of submitting a request.

c. *System Knowledge*

When using the Itinerary feasibility engine there is a need for detailed information about airports, aircraft and other details need to be available on demand and be able to check the proposed itinerary instantly against these variables. As seen in the Intellijet II reservations application, there is a need for the reservation agent to ensure the flight can be carried out as promised when they confirm a customer's itinerary. This same level of assurance needs to be present when a scheduler dedicates the required assets to a request and notifies the validator to pass on to the requestor. Once that mission has been scheduled the system needs to constantly check to ensure that promise to support a request will be successfully executed.

d. *Support Agency Integration*

Crucial to the design of a new system that gains the widest acceptance and usage is the involvement of all of the flying unit's users and components. Taking an extended enterprise approach to incorporate those outside activities that directly effect JOSAC's mission would allow for higher quality and current information to pass between all involved parties. Similar to how Intellijet links NetJets outside support agencies, such as catering or ground transportation, JOSAC's new system could incorporate maintenance functions and other support activities. To ensure widespread usage and to replace the various systems currently in use, the new system should include a baseline web based application that meets the user's needs, but is flexible enough to allow some customization. Consolidating maintenance efforts to one system eliminates duplicated effort, which was one factor preventing JOSAC from receiving the most up-to-date aircraft status.

The same concept would need to be in place for the flying unit scheduler's application. Ensuring the application is easy to operate and make changes will give the schedulers the flexibility to provide JOSAC with the best information. Finally, the

system should incorporate a collaboration tool for the flying unit's scheduler and JOSAC's scheduler to work out potential overnight trips. This feature could also be used to make special requests, providing an easy communication method to prepare trip details.

e. *Efficient Scheduling Solutions and Forecast Simulation*

The current JALIS system is no more than a tracking tool for the schedulers requiring them to utilize their knowledge in every scheduled mission. The new system could capture the scheduler's knowledge into an automated format that could generate schedules. The schedulers could then check the schedules for any special cases, reducing their workload. The scheduler's applications should use a graphical display to show the various schedule inputs in order to generate the master schedule. For example, a timeline bar could be used to view all assets and requests with color coded priority levels. There is a need to directly implement JOSAAMS into the new system or preferably develop an optimization tool that can make smart decisions based on a rule set established by the user to generate these schedules. While this feature could process more information faster than a human scheduler, it would be nearly impossible to capture every caveat of a scheduler's knowledge. To produce the best schedule would require someone to review the system's results and make changes accordingly. Another feature needed by the schedulers would be a versatile mission simulator that could incorporate unique circumstances into an itinerary, allowing the schedulers to see the projected results caused by an itinerary change before the change is implemented.

f. *User Interaction, Communication*

To ensure that missions that have been committed to get the required assets, there is the requirement for the system to constantly monitor the effects of changes to any detail. Providing daily updates to all users from ten days out until 72 hours prior to the flight would allow users to manage these changes to accomplish the mission. Changes need to be addressed as soon as they occur within the 72 hour period prior to takeoff, requiring an instant notification system to all those involved with the mission.

Utilizing a data alert messaging system is critical to making JOSAC capable of accommodating on-demand requests and changes. The system needs to implement a way to verify messages that have been received, and relay the response back to the system from the unit or customer. Having the capability to push and pull information keeps communications at the highest level of increased awareness. Because flight crews are constantly interacting with the system in remote locations, a wireless internet capable text device, such as a Blackberry, would allow the crews to provide real-time feedback to the operations center. Wireless capability would also allow the execution team to have the best information for making time critical decisions.

g. *Accountability and Reporting*

To handle modification changes, the system could generate an interactive task list sent to the involved users. This task list would ensure that the users accomplish the required actions under the pressure of time sensitive actions. During the execution phase of the mission, the system needs to keep the operation center's personnel updated on the status of all flights in progress, and allow them to see estimated arrival times. Incorporating a seamless integration with the FAA's ETMS would provide tracking capabilities in which the data passed down for specific flights could automatically update the status of future missions.

The Blackberry device used by flight crews could be used to instantly log mission details and reports. This device could also be used to automate the reporting process while eliminating errors caused by filing at a later time. When operating in remote locations, the flight crew must file a flight plan and manifest before departure. The manifest contains a listing of the names of scheduled and space available passengers. Rather than calling over a phone, a wireless internet device would directly input the required data into the system.

h. *JOSAC DSS Conclusion*

Improvements to JALIS at this point in its lifecycle would see limited returns for the amount of work and adjustment required to bring it to the level of Intellijet II. The original designers of NALIS never had many of the new applications available to

the designers of Intellijet II when NALIS was first designed. The most effective approach for improving JOSAC's system would be to start over new; incorporating an architecture that can handle the new features and potential future applications. Overall, the proposed system would help increase customer satisfaction by providing better information to those who are serving the customer. The system would increase operational effectiveness by allowing schedulers to fill more requests in a timelier manner, to destinations that are best suited for the customer. Operational efficiency would be improved by utilizing the optimization scheduler finding the best way to meet the most customer demands. Accountability would be increased by allowing the system's users to directly input the required request or flight information. The system's involvement in all aspects of JOSAC's operations, and their supporting units and agencies, enables JOSAC to make an enterprise-wide improvement.

2. Operations

While JOSAC's mission is to support DoD customers and not to generate a profit, there is an opportunity to use business processes to better serve customers with decreased resources. JOSAC has the potential to transform into a microjet network by utilizing the proposed DSS, adjusting operational strategies and harnessing the disruptive technology of microjets. This section recommends changes to JOSAC's operation strategies, and explains the potential benefits of utilizing microjets.

a. Strategy Recommendations

JOSAC needs to align their mission with the flying unit's mission in order to eliminate contradicting actions. The current system indirectly encourages the flying units to make decisions based on their own savings, rather than the greater good of the JOSAC operation. The JOSAC system could use an incentive such as a payment from JOSAC to the units carrying out the mission for filling requests. Incentives are also needed for accommodating overnight trips or other unique scheduling situations that could provide better service in a more efficient manner. By allocating funds to JOSAC for distribution to flying units who make their assets available, the units are provided with the incentive to act more like a business, diminishing wasted empty flight legs.

JOSAC could benefit by becoming an on-demand, dynamic organization. To accomplish this goal, JOSAC should utilize the DSS's ability to handle changes and provide its users with better, faster decision quality information. In order to motivate JOSAC and the flying units to act in a dynamic way, the standards for meeting a larger number of requests need to be raised. The flying units need to give JOSAC wider time blocks of crew availability, enabling JOSAC to put more than one crew on alert status. Greater crew availability would allow JOSAC to respond to more last minute requests. These last minute requests are usually ones in which the customer is in dire need of private air travel to get to a destination as soon as possible. JOSAC could provide the greater benefit over other modes of travel by helping the customer during this time of need to achieve this transformation. JOSAC as an organization needs to be given the flexibility to schedule flight crews in a way that allows them to have a larger percentage of assets and flight crews on alert, ready to meet customer demand in a timely manner.

b.   *Aircraft Recommendations*

The two aircraft that make up the majority of OSA's fleet are the C-21 and C-12, making up 66% of the CONUS fleet. The C-21 was acquired in 1984-85 and the C-12 between 1984 and 1994. While these aircraft are still in sound operating condition, they are less cost effective than microjets and could reach their useful life expectancy in the next ten years. If a microjet replaced both the C-12 and C-21 flying OSA missions, it could yield large cost savings such as operating costs, crew costs and availability, travel time savings and acquisition costs. Each aircraft's characteristics and costs are laid out in Table 5. Operating costs consists of fuel costs of $2.00 per gallon, oil, regular maintenance and engine reserve. This estimate does not include the cost for flight crew personnel.

Table 5.　Aircraft Comparison　(After http://www.planequest.com/operationcosts, http://www.eclipseaviation.com/500jet/comparisons.htm)

Aircraft Name	Operating Cost per Hour	per Mile	Cruise speed (mph)	Range (nm)	Passengers	Initial Acquisition Cost	# of aircraft	Required Crew
Eclipse 500	$298	$0.69	430	1400	5	$1,250,000	*412 est.*	1
C-21 Lear Jet 35A	$739	$1.71	430	2200	8	$4,686,000	52	2
C-12 King Air 200C	$473	$1.72	275	1900	6	$2,345,000	116	2

(1)　Operating and Acquisition Cost:　The Eclipse 500 stands out from the C-21 and C-12 when comparing financial statistics.　Based on cost per hour, the Eclipse 500 is less than half the cost of the C-21, and provides a 37% cost savings over the C-12.　This metric demonstrates how cost effective the aircraft is to operate over its lifetime.　Since most aircraft component's useful life are measured by operating hours, such as engine time until a major overhaul is required, this metric is a good indicator of aircraft life cycle costs.　When comparing aircraft based on cost per mile, the Eclipse 500 provides a 60% savings over the other aircraft.　This measure provides an accurate metric to evaluate how efficiently the aircraft can operate over a specified distance.　To truly use this metric for aircraft comparison, cruise speed needs to be considered.　The aircraft may cost the same, but one may complete the journey faster.　When comparing the aircrafts' acquisition costs, JOSAC could have bought 412 Eclipse 500's for the same price as they paid for the 52 C-21 and 116 C-12 aircraft.　By having nearly three times the amount of aircraft, JOSAC would be able to meet a much larger percentage of customer requests.

(2)　Aircraft Performance and Capability Comparison:　The performance factor with the largest difference between these aircraft is their range.　The Eclipse 500 requires a refueling stop when flying coast to coast across the country, whereas the C-21 and C-12 can fly most CONUS flights nonstop.　The need to refuel detracts from the appeal of the Eclipse 500.　However, the time needed for refueling is compensated for with a faster cruise speed when compared to the C-12.　The passenger capacity of the Eclipse 500 is smaller than a C-21, carrying three less passengers. But on

the majority of flights these additional seats would be left empty in most circumstances. The Eclipse 500's low acquisition cost offsets this shortcoming, as two Eclipse aircraft carrying ten passengers would still cost less than taking one C-21 carrying eight passengers.

c. *Potential Cost Savings*

Based on the number of sorties flown by OSA in 2002, and assuming an average sortie distance of 500 miles, Table 6 shows the potential annual operating cost savings if the Eclipse 500 replaced the C-21 or C-12. This break down does not take into account additional savings gained by having a single crew member required to operate the aircraft, or the subsequent increase in air crew availability. The faster cruise speed of the Eclipse 500 could save a total of 22,005 hours over the year for travelers and for the unit's flight time allocation.

Table 6.   Potential Annual Operating Cost Saving from using Eclipse 500 Microjet

Average sortie distance 500 miles	Savings per mile	Travel Time savings (hr)	Percent of Fleet	Sorties	Operating Cost Savings
Savings over C-21	$1.02	0	21%	15301	$7,803,351
Savings over C-12	$1.03	0.656	46%	33544	$17,275,065
Total		22005	66%	73561	$25,078,416

Overall, utilizing the Eclipse 500 for JOSAC missions has the potential to save OSA a total of at least $25 million per year in operating costs. The potential benefit of reducing the number of required flight crew from two to one might not be in the form of cost savings, but will likely increase the availability for JOSAC to schedule these personnel. Increased crew availability, along with a larger fleet of microjet aircraft, would allow JOSAC a greater amount of flexibility to meet the dynamic demand of their customers. The on-demand microjet travel could be opened up to a larger population of military personnel because more requests could be filled by the larger fleet of aircraft, requiring less personnel to operate them, by acting in a highly efficient manner able to meet the changing demands of the customer.

C. MAJOR RECOMMENDATIONS

JOSAC could vastly improve its current operations and JALIS, while reducing costs and improve its overall mission effectiveness. Creating a DSS which adapts the features of Intellijet II to the unique requirements of JOSAC's operations is crucial to transforming the organization.

- Restructure JOSAC and flying unit incentives to align all organizations through the use of JOSAC ownership of aircraft or JOSAC payment to servicing flying unit.

- Incorporate microjet aircraft instead of C-21 and C-12 to realize annual operating cost savings of $25 million.

- Implement a new DSS system as an investment in efficiency by, better utilization of assets and increased customer satisfaction.

These improvements, along with capturing the benefits of microjets, have the power to transform the organization into a highly valued, cost efficient microjet network which provides a unique travel alternative to a broader population of DoD travelers.

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